Indicators of collaboration in energy innovation systems – what is needed and what is possible?

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Indicator schemes for assessing the performance and dynamics of innovation systems have until now only to a small extent contained indicators of collaboration and interaction in the innovation systems. This is striking, as one of the main points of innovation system research in general is that the patterns of interaction constitute a key factor for the resulting innovative performance and strength of an innovation system. Also studies of innovation networks and transition processes towards sustainable energy systems and studies of energy technology development have pointed out the patterns of interaction and collaboration as important factors for the outcome of innovation processes.

Building on a combination of innovation system theory and transition theory, the purpose of this paper is to show the results of an investigation of the questions: 1) what relevant indicators of collaboration and interaction in energy innovation systems are currently available; and 2) can new indicators be established that improve our knowledge of the patterns of interaction and the role they play for transitions towards more sustainable energy systems? The study more specifically builds on the concepts of modes of innovation from innovation system literature (Jensen et al. 2005) and the finding that combination and integration of different types of learning and knowledge build up are important for succeeding in innovation. Experienced based know-how and knowledge build-up in industrial and application contexts (learning-by-doing, learning-by-using and learning-in-interaction (DUI)) are as important as are formalized scientific and technological knowledge production (STI). In parallel to this perspective, the study employs the multi-actor perspective from transition studies, network studies, and the studies of technology-specific innovation systems (Geels 2004, Musiolik et al. 2012, Powell and Grodal 2005, Hekkert et al. 2007).

The methodology of the study has two main elements: Firstly, an extensive review of literature, statistics schemes, and data bases that deal with indicators of energy innovation systems, indicators of innovation systems in general, or indicators of energy systems and deployment of new energy technologies. Included in the review are both research activities and activities by formal statistics organisations and other practitioners in the field. Secondly, building on identified limitations in the existing statistics and indicator schemes, a questionnaire survey about innovation activities and interaction in the energy area in Denmark is made. It

distinguishes between different areas of energy technology, with emphasis on low-carbon technologies. The questionnaire had more than 400 respondents, equaling in the order of 1/4 of the actors in energy innovation in Denmark. The survey method is fruitful for present-day studies. For historical research it will usually not be feasible and other measures based on secondary data would be needed.

The picture of a limited attention to collaboration activities in existing official indicator schemes is confirmed by the study. Among the exceptions are in some cases STI indicators like university-industry collaboration. DUI aspects like collaborations in industrial supply-chain networks, between developers and users, or between the different actors in and around the energy systems (energy companies, consumers, technology suppliers, policy actors, regulators, interest organizations, etc.) are less often addressed. Moreover, there is usually not attention to differences between different energy technology areas.

The results of the survey among the actors in the Danish energy area show that it is possible to establish further indicators of collaboration and interaction in energy innovation systems, including DUI indicators. Not only did it make sense to the respondents to answer questions about collaboration activities and interaction processes; the results also show that collaboration and interaction processes normally play an important role for the innovation. Both formalized collaboration projects and more informal collaboration in networks, interest groups, public discussions, etc. are carried out as part of the innovation activities. Public-private collaboration activities often occur in the Danish energy innovation system. The study moreover shows that there are differences in the patterns of collaboration between different areas of energy technology, hence confirming the insight from other studies that innovation system dynamics are not homogeneous, but varies between technology areas and between regions and countries.

To sum up, it can be concluded that there are fruitful improvements to be made to indicator schemes of energy innovation systems by addressing collaboration and interaction activities more elaborately than done hitherto. Important new insight in energy innovation and transition processes towards sustainable energy systems can be obtained. An additional point is that clear and simple indicators in many cases offer more useful knowledge than complex indicators and composite indicators, that integrate a number of indicators in one, amongst other things because the former often are easier to connect to other, more qualitatively based bits of knowledge.

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